

**Attachment 8.2 –Supporting Documents**

**Water Quality and Other Expected Benefits**

**Project B – Ash Slough Arundo Eradication and Sand Removal Project**

**Madera Region – IRWM Implementation Grant Application**

**Table of Contents**

Global Invasive Species Database: Ecology of Arundo	3
Photos of Arundo Infestation in Ash Slough	9
FIRM Map documentation of Slough width	13

Page Left Intentionally Blank

**Attachment 8.2, Global Invasive Species Database: Ecology of Arundo**

Page Left Intentionally Blank

## *Arundo donax* (grass)

**Taxonomic name:** *Arundo donax* (L.)

**Synonyms:** *Aira bengalensis* (Retz.) J.F. Gmel., *Amphidonax bengalensis* (Retz.) Nees ex Steud., *Amphidonax bengalensis* Roxb. ex Nees., *Amphidonax bifaria* (Retz.) Nees ex Steud., *Arundo aegyptiaca* hort. ex Vilm., *Arundo bambusifolia* Hook. f., *Arundo bengalensis* Retz., *Arundo bifaria* Retz., *Arundo coleotricha* (Hack.) Honda., *Arundo donax* var. *angustifolia* Döll., *Arundo donax* var. *coleotricha* Hack., *Arundo donax* var. *lanceolata* Döll., *Arundo donax* var. *procerior* Kunth., *Arundo donax* var. *versicolor* (P. Mill.) Stokes, *Arundo glauca* Bubani., *Arundo latifolia* Salisb., *Arundo longifolia* Salisb. ex Hook. f., *Arundo sativa* Lam., *Arundo scriptoria* L., *Arundo versicolor* P. Mill., *Cynodon donax* (L.) Raspail., *Donax arundinaceus* P. Beauv., *Donax bengalensis* (Retz.) P. Beauv., *Donax bifarius* (Retz.) Trin. ex Spreng., *Donax donax* (L.) Asch. and Graebn.

**Common names:** arundo grass (English), bamboo reed (English), caña (Spanish), caña común (Spanish), caña de Castilla (Spanish), caña de la reina (Spanish), caña de techar (Spanish), cana- do-reino (Portuguese-Brazil), cana-do-brejo (Portuguese-Brazil), cane (English), canne de Provence (French), canno-do-reino (Portuguese-Brazil), capim-plumoso (Portuguese-Brazil), carrizo (Spanish), carrizo grande (Spanish), cow cane, donax cane (English), fiso palagi (Samoan), giant cane (English), giant reed (English), grand roseau (French), kaho (Tongan-Tonga Islands), kaho folalahi (Tongan-Tonga Islands), la canne de Provence (French- New Caledonia), narkhat (Hindi), ngasau ni valalangi (Fijian-Fiji Islands), Pfahlrohr (German), reedgrass (English), river cane (English), Spaanse-riet, Spanisches Rohr (German), Spanish cane (English), Spanish reed (English), wild cane (English)

**Organism type:** grass

*Giant reed (Arundo donax) invades riparian areas, altering the hydrology, nutrient cycling and fire regime and displacing native species. Long 'lag times' between introduction and development of negative impacts are documented in some invasive species; the development of giant reed as a serious problem in California may have taken more than 400 years. The opportunity to control this weed before it becomes a problem should be taken as once established it becomes difficult to control.*

### **Description**

*Arundo donax* is a very tall and robust bamboo-like, perennial grass with large, spreading clumps of thick culms to 6.1 m tall. The numerous leaves are about 5 cm wide and 30.5-61 cm long, and arranged conspicuously in two opposing ranks on the culms. The leaves look like those of a corn plant. Their margins are sharp to the touch and can cut careless hands. The inflorescence, appearing in late summer, is a 0.3-0.6 m long purplish, aging to silver, plume that stands above the foliage. Giant reed spreads from thick, knobby rhizomes. Once established, it tends to form large, continuous, clonal root masses, sometimes covering several acres. These root masses can be more than 1 m thick. The foliage dries to light brown in the winter and rattles in the wind. Striped giant reed (*A. donax* var. *versicolor*, has leaves with bold white stripes, and is a smaller plant, to 2.4 m tall (Christman, 2003; McWilliams, 2004).

### **Occurs in:**

agricultural areas, coastland, desert, natural forests, planted forests, range/grasslands, riparian zones, ruderal/disturbed, scrub/shrublands, urban areas

### **Habitat description**

*Arundo donax* is a hydrophyte, and grows best where water tables are near or at the soil surface. It establishes in moist places such as ditches, streams, and riverbanks, growing best in well drained soils where abundant moisture and sunlight is available. *A. donax* has also been demonstrated to prefer areas with enriched nitrogen levels. It tolerates a wide variety of conditions, including high salinity, and can flourish in many soil types from heavy clays to loose sands. It is well adapted to the high disturbance dynamics of riparian systems. *A. donax* inhabits USDA zones 6-11 (Benton *et al.*, 2006; Ambrose & Rundel, 2007).

### **General impacts**

Dense populations of *Arundo donax* affect riversides and stream channels, compete with and displace native plants, interfere with flood control, and is extremely flammable increasing the likelihood and intensity of fires. It may establish a invasive plant-fire regime as it both causes fires and recovers from them 3-4 times faster than native plants. It is also known to displace and reduce habitats for native species including the [Federally endangered Least Bell's Vireo \(\*Vireo bellii\*\)](#).

Its long, fibrous, interconnecting root mats of giant reed form a framework for debris behind bridges, culverts, and other structures that can effect their function and disturb ecosystems. Its rapid growth rate, estimated 2-5 times faster than native competitors, and vegetative reproduction, it is able to quickly invade new areas and form pure stands. Once established, *A. donax* has the ability to outcompete and completely suppress native vegetation, reduce habitat for wildlife, and inflict drastic ecological change (Benton *et al.*, 2006; McWilliams, 2004; Ambrose and Rundel, 2007; Rieger & Keager, 1989).

#### **Uses**

*Arundo donax* is grown as an ornamental for its striking appearance, purplish stems, and for the huge feather-like panicles of purplish flowers. It is the largest and tallest ornamental grass other than bamboo, and the tallest grass that can be grown outside the tropics. The large, thick and fluffy flower plumes are used in floral arrangements. *A. donax* is also used to make reeds for woodwind instruments and were once used for organ pipes. Giant reed is commonly planted in wet soils to reduce erosion (Christman, 2003). In folk medicine, the rhizome or rootstock of *Arundo donax* is used for dropsy. Boiled in wine with honey, the root or rhizome has been used for cancer. This or other species of *Arundo* is also reported to be used for condylomata and indurations of the breast. The root infusion is regarded as antilactagogue, depurative, diaphoretic, diuretic, emollient, hypertensive, hypotensive, and sudorific (Duke, 1997).

#### **Geographical range**

Native range: Afghanistan, Algeria, Azerbaijan, China, Cyprus, Egypt, Georgia, India, Indochina, Iran, Iraq, Israel, Japan, Jordan, Lebanon, Libya, Myanmar, Nepal, Pakistan, Saudi Arabia, Syria, Taiwan, Tunisia, Turkey, Turkmenistan, Ukraine, Uzbekistan

Known introduced range: Argentina, Australia, Bangladesh, Bermuda, Bolivia, Brazil, Cayman Islands, Chile, Cook Islands, Costa Rica, Dominican Republic, Ecuador, El Salvador, Fiji, French Polynesia (Polynésie Française), Gibraltar, Guam, Guatemala, Haiti, Indonesia, Italy, Kiribati, Mexico, Micronesia, Namibia, Nauru, New Caledonia (Nouvelle Calédonie), New Zealand, Nicaragua, Norfolk Island, Palau, Peru, Portugal, Samoa, South Africa, Suriname, Swaziland, Tonga, United States (USA), Uruguay, Venezuela

#### **Introduction pathways to new locations**

Agriculture:

Floating vegetation/debris:

Landscape/fauna "improvement":

Nursery trade: Canes traditionally cultivated for variety of uses - fencing, thatch, framing, musical instruments and woodwind reeds; carried esp. by Spanish colonists.

#### **Local dispersal methods**

Garden escape/garden waste: Available in nursery trade.

Translocation of machinery/equipment (local):

Water currents: Floods break up clumps of *Arundo donax* and spread pieces downstream where they can take root and establish new clones (McWilliams, 2004).

Wind dispersed: The hairy, light-weight disseminules (individual florets with the enclosed grain) are dispersed by wind (McWilliams, 2004).

#### **Management information**

Preventative measures: A [Risk assessment of \*Arundo donax\* for Australia](#) was prepared by Pacific Island Ecosystems at Risk (PIER) using the Australian risk assessment system (Pheloung, 1995), resulting in a score of 12 with a recommendation "to reject the plant for import (Australia) or species likely to be of high risk (Pacific)".

Chemical: The use of systemic herbicides such as glyphosate or fluazipop applied after flowering either as a cut stump treatment or foliar spray have been found to control *Arundo donax*. Caution should be taken when using such herbicides around water or in wetlands (Benton *et al.*, 2005; PIER, 2008).

Physical: Hand pulling may be effective at removing small infestations of *Arundo donax*, but care must be taken to remove all rhizomes to prevent re-establishment. Cutting is not recommended unless the rhizomes are dug up, as tiny rhizomes can grow into new colonies. Burning is not recommended either as it has been demonstrated to aid the growth of *Arundo donax* because it regrows 3-4 times faster than native plants (PIER, 2008; Ambrose & Rundel, 2007).

**Biological control:** Native flora and fauna typically do not offer any significant control potential of *Arundo donax*. It is uncertain what natural controlling mechanisms for giant reed are in its countries of origin, although corn borers, spider mites, and aphids have been reported in the Mediterranean. A sugar cane moth-borer in Barbados is reported to attack giant reed, but it is also a major pest of sugar cane and is already found in the United States in Texas, Louisiana, Mississippi, and Florida. A leafhopper in Pakistan utilizes *A. donax* as an alternate host but attacks corn and wheat. In the United States a number of diseases have been reported on giant reed, including root rot, lesions, crown rust, and stem speckle, but none seem to have seriously impacted advance of this weed. Giant reed is not very palatable to cattle, but during the drier seasons they will graze the young shoots, followed by the upper parts of the older plants. However, in many areas of California the use of Angora and Spanish goats is showing promise for controlling *A. donax*. Also an unidentified stem-boring sawfly that appears similar to *Tetramesa romana* has been demonstrated to cause significant damage to *A. donax*, and it is being tested in quarantine as a candidate biocontrol agent for it (McWilliams, 2004; Dudley *et al*, 2006).

**Integrated management:** A popular approach to treating giant *Arundo donax* has been to cut the stalks and remove the biomass, wait 3 to 6 weeks for the plants to grow about 1 m tall, then apply a foliar spray of herbicide solution. The chief advantage to this approach is less herbicide is needed to treat fresh growth compared with tall, established plants, and coverage is often better because of the shorter and uniform-height plants. However, cutting the stems may result in plants returning to growth-phase, drawing nutrients from the root mass. As a result there is less translocation of herbicide to the roots and less root-kill. Additionally, cut-stem treatment requires more time and personnel than foliar spraying and requires careful timing. Cut stems must be treated with concentrated herbicide within 1 to 2 minutes of cutting to ensure tissue uptake. This treatment is most effective after flowering. The advantage of this treatment is that it requires less herbicide and the herbicide can be applied more precisely. It is rarely less expensive than foliar spraying except on very small, isolated patches or individual plants (McWilliams, 2004).

#### **Nutrition**

*Arundo donax* photosynthesizes through C3 fixation which requires abundant sunlight and moisture. It has also been demonstrated to prefer areas with enriched nitrogen levels (Lewandowski *et al*, 2003; Benton *et al*, 2006; Ambrose & Rundel, 2007).

#### **Reproduction**

Reproduction of *Arundo donax* is primarily vegetative by way of rhizomes which root and sprout readily and layering in which stems touching the ground sprout roots. Layering has been demonstrated to expand *A. donax* as much as 7.4 times faster than spread by rhizomes but is thought to only occur within flood zones. *A. donax* tends to form large, continuous, clonal root masses, sometimes covering several acres. It very rarely produces seeds and very little is known about its sexual reproduction (Benton *et al*, 2006; Boland, 2006; McWilliams, 2004)

**This species has been nominated as among 100 of the "World's Worst" invaders**

**Reviewed by:** Tom Dudley Marine Science Institute University of California Santa Barbara & Natural Resource & Environmental Sciences University of Nevada, Reno. United States

**Principal sources:** [McWilliams, John D. 2004. \*Arundo donax\*. In: Fire Effects Information System, \[Online\]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory \(Producer\).](#)

[Pacific Island Ecosystems at Risk \(PIER\), 2006. Risk Assessment \*Arundo donax\* L., Poaceae](#)

**Compiled by:** Profile revision: National Biological Information Infrastructure (NBII) & IUCN/SSC Invasive Species Specialist Group (ISSG)

To contribute information, please contact [Shyama Pagad](#).

**Last Modified:** Thursday, 23 March 2006

Page Left Intentionally Blank

**Attachment 8.2, Photos of Arundo Infestation in Ash Slough**

Page Left Intentionally Blank

**Ash Slough Arundo Eradication Project – Photos of Arundo in Ash Slough**



Ash Slough adjacent to the City of Chowchilla. Dense greenery is Arundo Infestation



Arundo infestation spreading to adjacent agricultural areas

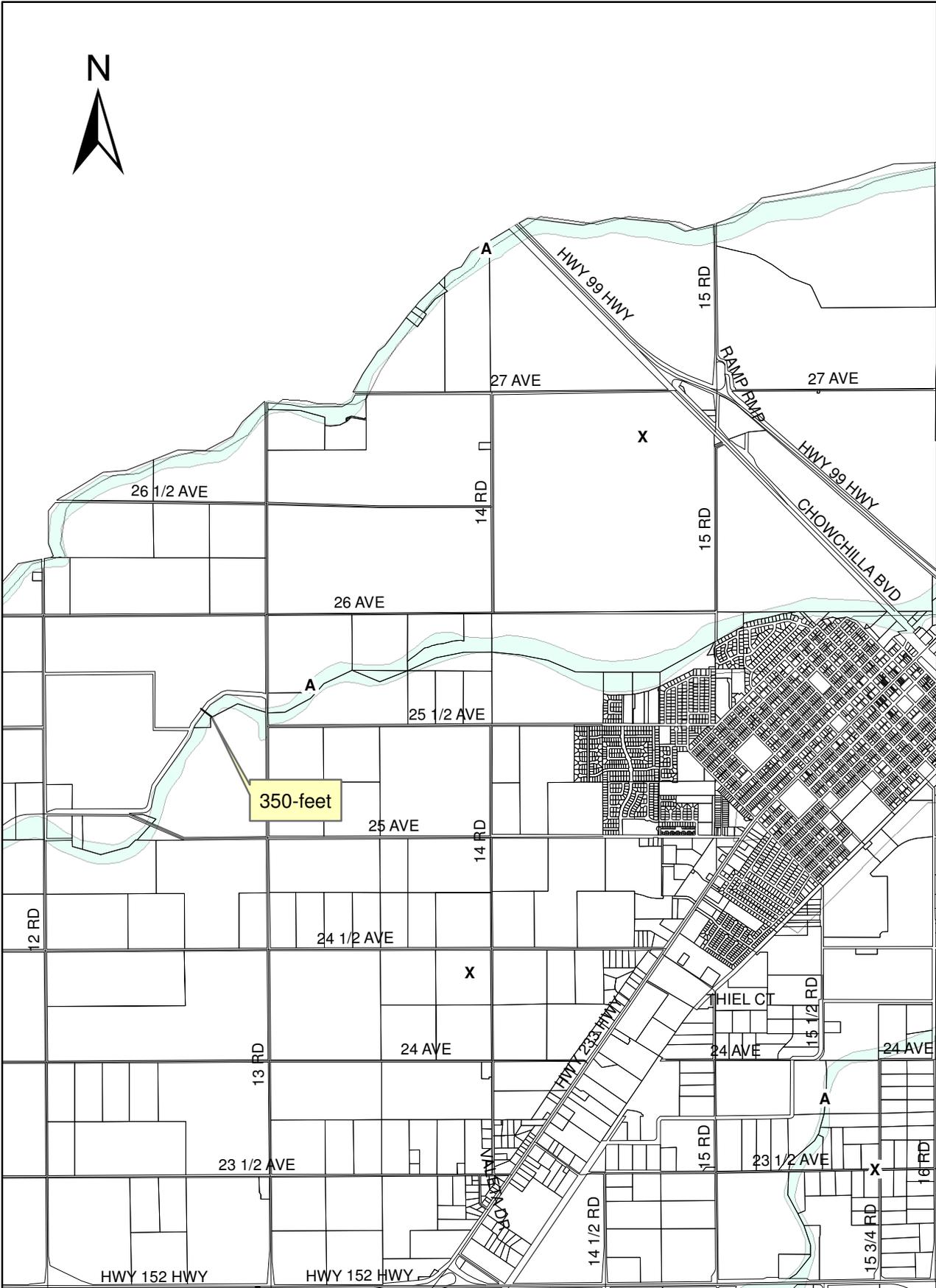
## Ash Slough Arundo Eradication Project – Photos of Arundo in Ash Slough



Un-managed Arundo canes can grow to 20 feet in height. Canes are cut and allowed to re-sprout prior to spraying for more effective eradication.

**Attachment 8.2, FIRM Map documentation of Slough width**

Page Left Intentionally Blank



350-feet

Page Left Intentionally Blank